Effect of Signed vs Unsigned Prediction Error on Declarative Memory

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Introduction

Prediction error is widely agreed to drive learning and memory.

A recent study showed that signed reward prediction error during declarative learning improved recognition (De Loof et al., 2018).

In a word-learning paradigm with extrinsic financial reward, recognition was shown to be better for items with a positive outcome at encoding, in proportion to size of prediction error.

However, previous studies in our group (without financial reward) have shown that memory is driven by the absolute magnitude of prediction error (PIMMS framework; Greve et al. 2017).

Using the paradigm and materials from De Loof and colleagues (2018), we ran two experiments:
- Experiment-I without financial reward
- Experiment-II with financial reward

De Loof and colleagues' experiments were conducted in person, so we collected data in-person as well as online. Experiments were powered for twice the effect size of De Loof et al.

Alternative Explanation

Simulation code available at https://osf.io/b48ga/

Preference at Encoding → Bias at Retrieval

If no memory, only linguistic preference:

More realistically (but without any PE):

Linear Mixed Effects Models

Hit = Prediction Error • [1 (translation)] • [1 (subject)]
Correct Rejection = Prediction Error • [1 (translation)] • [1 (subject)]

Accuracy ~ Signed Prediction Error²

Accuracy ~ Unsigned Prediction Error

Comparing Signed vs Unsigned Models

AIC for Signed Prediction Error = 9326.3
AIC for Unsigned Prediction Error = 9310.4

Discussion

Across two experiments, we largely replicated the results from De Loof and colleagues (2018), and found that:
- Extrinsic financial reward did not change the pattern of results.
- The pattern of results could be slightly better explained by the absolute magnitude of prediction error.
- Results were consistent whether the data was collected in-person or online.
- The pattern of results can be explained without prediction error. We propose small modifications and a different memory task to better test the effects of signed vs unsigned prediction error in follow-up experiments.

References